This document includes the Summary of Impacts – Flexible (NonAluminum) Hulls Vessel Group for the Draft Hull Coating Leachate Discharge Assessment Report published in August 2003. The reference number is: EPA-842-D-2006-002

DRAFT
Discharge Assessment Report
Hull Coating Leachate

Summary of Impacts and Characterization for Flexible (Non-Aluminum) Hulls Vessel Group

August 2003

5 Summary of Impacts – Flexible (Non-Aluminum) Hulls Vessel Group

The Flexible (Non-Aluminum) Hulls vessel group includes 59 vessels. This accounts for 1.9% of the vessels and 8.1% of the wetted hull surface area that produce Hull Coating Leachate discharge. All of the vessels in this group are Navy vessels. The USS LOS ANGELES (SSN 688) Class has been chosen as the representative vessel for this group.

5.1 Characterization of Flexible (Non-Aluminum) Hulls Vessel Group

Vessels with flexible hulls use the same copper ablative coatings (i.e., International Interspeed 640 (BRA640) and Ameron Coatings ABC #3) as the Steel, Composite, and Other Non-Aluminum Rigid Hulls vessel group. Although used on some vessels to achieve a 12-year docking periodicity, copper ablative antifouling coatings typically have a three-year service life when applied to a flexible hulled vessel. The difference in estimated service life between vessel groups is due to the thickness of the copper ablative coating and the observed tendency of ablative coatings to crack when applied over the flexible substrate. The reduced service life of the ablative coating does not interfere with operations, because submarines are docked more frequently than surface ships. Navy research continues to search for coatings that may be more suitable to the flexible exterior of these vessels.

The baseline discharge from this vessel groups is a result of constituents leaching from copper ablative coatings. A combination of information received from coating manufacturers and government studies are the basis for all estimations and calculations. Constituent concentrations at 1 cm from the hull and release information for the baseline discharge are presented in Table 5-1. As discussed in the *Hull Coating Leachate ChAR*, any VOCs present in coatings were assumed to dissipate during the coating drying/curing process and are not included in the list of constituents discharged from the various coatings characterized.

Table 5-1. Constituent Information for the Baseline Discharge of the Flexible (Non-Aluminum) Hulls Vessel Group

Constituent	Concentration at 1 cm from the Hull (µg/l)	Release Rate (µg/cm^2/day)		Constituent Mass Loading (lb/vessel group-year)	TPE (lb-equiv/yr)	BCC Identified
		Static	Dynamic			
Total Copper	5.3[b]	8.9[b]	17.0[b]	7,600	14,000	Reduction
Total Iron	0.26[c]	0.44[c]	0.84[c]	380		No
N-ethyltoluenesulfonamide	0.31[c]	0.52[c]	1.2[c]			No
Plasticizer	0.28[c]	0.47[c]	1.1[c]			No
Polyamide resin	0.28[c]	0.47[c]	1.1[c]			No
Rosin	1.0[c]	1.6[c]	3.8[c]			No
Total Zinc	2.1[c]	3.6[b]	6.7[b]	3,100	210	Reduction

[a]Manufacturer information.
[b]Previous Navy Studies.
[c]Scaled from weight percentage or known release rate.

A complete description of the information collected, assumptions made, and calculations performed to estimate the concentrations and release rates is contained in the *Hull Coating Leachate ChAR.*

5.1.1 Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings

The discharge from this MPCD option group is the same as the baseline discharge. Information presented in Section 4.1 for the baseline discharge pertains to the discharge from this MPCD option group. Additional characterization and calculations were not necessary.

5.1.2 Foul-Release Coatings

As discussed in the *Hull Coating Leachate FIAR*, foul-release coatings were tested on an Australian submarine in the 1990s resulting in excessive hull fouling (DSTO, 1995; Holmdahl, 2000). Before foul-release coatings can be applied to U.S. Navy submarines, performance validation testing would be required on an existing Navy nuclear submarine to ensure that its mission would not be affected and that damage from fouling would not occur to critical shipboard systems. Validation testing has not been done. Therefore, the foul-release coatings MPCD option is not feasible for this vessel group, and no characterization data was developed.

5.1.3 Advanced Antifouling Coatings

The advanced antifouling coating, *E Paint SN-1*, has not met the minimum performance requirements of military specification MIL-PRF-246-47 and is not authorized for use on Navy vessels (Lawrence, 2003). Therefore, the Advanced Antifouling Coatings MPCD option is not feasible for this vessel group, and no characterization data was developed.

5.2 Feasibility Impact Analysis of Flexible (Non-Aluminum) Hulls Vessel Group

The feasibility analysis assessed the practicability and operational impact of the three MPCD options groups as well as the cost to implement each MPCD option. The choice of hull coating directly affects a vessels ability to satisfy mission requirements as well as the normal drydocking and maintenance schedules for vessels. Costs to implement each MPCD option were estimated. Costs were estimated for all MPCD options to modify existing military specification, manuals, and contracts that determine which coating may be used on vessels. Also, costs connected with coating maintenance and replacement were included.

The MPCD option to Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings was the only option determined to be feasible. Incremental costs for this MPCD are limited to those for establishing the initial release rate limit and those to modify existing military specifications and manuals to incorporate the release rate standard. A numerical maximum allowable copper release rate standard would be based on the results of ongoing Navy testing using the American Society for Testing and Materials (ASTM) D 6442, *Standard Test Method for Copper Release Rates of Antifouling Coating Systems in Seawater*. A summary of the feasibility impacts by vessel group and MPCD option is presented in Table 5-2.

Table 5-2. Feasibility Impact Summary of the Flexible (Non-Aluminum) Hulls Vessel Group

MPCD Option	Analysis Factors				
	Mission Capabilities	**Drydock and Pierside Maintenance**	**Initial Costs ($K, in 1999 dollars)**	**12-year Recurring Costs ($K, in 1999 dollars)**	**Annualized Total Ownership Costs ($K, in 1999 dollars)**
Establish Maximum Copper Standard	None	None	36	310,000	26,000
Foul-Release Coatings	MPCD option is not feasible.				
Advanced Antifouling Coatings	MPCD option is not feasible.				

A complete description of the impacts identified, costs, and assumptions made is contained in the *Hull Coating Leachate FIAR.*

5.3 Environmental Effects Analysis of Flexible (Non-Aluminum) Hulls Vessel Group

The environmental effects were analyzed for the baseline discharge and discharges resulting from each MPCD option. Copper-containing coatings are the basis for the baseline discharge.

For purposes of this analysis, the MPCD option to Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings is not expected to alter the baseline discharge, but is anticipated to limit the use of high copper release coatings in the future. The foul-release coatings and advanced antifouling coatings MPCD options are not feasible; therefore, environmental effects were not analyzed. A summary of the environmental effects of the Hull Coating Leachate discharge for the various MPCD options and baseline discharge for this vessel group were evaluated and are summarized in Table 5-3.

Table 5-3. Summary of EEA for the Flexible (Non-Aluminum) Hulls Vessel Group

	Baseline Discharge	**Establish Maximum Copper Standard**	**Foul-Release Coatings**	**Advanced Antifouling Coatings**
Number of Constituents Exceeding Strictest WQC	1	1	NF	NF
Total Number of Exceeded WQC	Acute: 19 Chronic: 16	Acute: 19 Chronic: 16		
Number of Exceeded Narrative Categories	0	0		
Discharge Hazard Index at 35 m Edge of Mixing Zone	$7.0x10^{-3}$	$7.0x10^{-3}$		
Potential Nonindigenous Species Release	Low	Low		
Number of BCCs Identified	2	2		
Discharge Mass Loading of All Constituents (lb/yr)	11,000	11,000		
Discharge TPE (lb-equiv/yr)	14,000	14,000		
Other Environmental Impacts – VOC emissions, solid waste generated	Not quantified	Same as baseline		

NF = MPCD Option was determined to not be feasible.

In summary, the option to Establish Maximum Allowable Copper Release Rate Standard for Antifouling Coatings is the only feasible MPCD option for this vessel group. Additional information on the environmental effects analysis is included in the *Hull Coating Leachate EEAR*.

5.4 Cost-Effectiveness Analysis of Flexible (Non-Aluminum) Hulls Vessel Group

As a means of comparing the various MPCD options, the incremental pounds removed for each MPCD option is compared to the baseline discharge. These pounds are then compared with the incremental cost of each MPCD option. Finally, a cost per pound removed is calculated and used to compare the MPCD option cost-effectiveness. The comparison results are presented in Table 5-4. As shown below, the MPCD option to Establish a Maximum Allowable Copper

Release Rate for Antifouling Coatings would result in no change in the total pounds discharged from baseline at an incremental cost of $3,000 per year.

Table 5-4. Cost-Effectiveness Analysis of MPCD Options for the Flexible (Non-Aluminum) Hulls Vessel Group

	Establish Maximum Copper Standard	Foul-Release Coatings	Advanced Antifouling Coatings
Incremental TPE Removed from Baseline (lb-equiv removed/yr)	0	NF	NF
Incremental Annualized Cost from Baseline ($K, in 1999 dollars)	3		
Incremental Cost per TPE Removed ($/lb-equiv removed)	N/A		

N/A = The incremental cost per pound removed is not applicable when the incremental TPE removed is zero.

NF = MPCD Option was determined to not be feasible.